

**INSTITUTIONAL SUPPORT TO
THE MINISTRY OF TRANSPORT

COMPUTER SYSTEMS REPORTS**

Submitted to:
USAID/Malawi
Lilongwe, Malawi

Submitted by:
Institutional Reform and the Informal Sector (IRIS)
2105 Morrill Hall
University of Maryland, College Park
College Park, MD 20742
USA

Prepared for:
Nathan and Associates Inc.
John W. Fox
6220 West Freeland Road
Freeland, MI 48623

**Malawi Ministry of Transport Project
Contract: PCE-I-00-97-00042-00
Task Order: 805**

COMPUTER SYSTEMS

This report outlines the software, hardware, peripheral system components, installation, training, and system support that should be implemented to improve data storage, data maintenance, and information retrieval for strategic decision support, management support, and Ministry of Transport effectiveness.

1.1 INTRODUCTION

1.1.1 Background

It is the desire of the Government of Malawi, and the purpose of the information and recommendations contained in the IRIS project reports, to enhance Ministry of Transport (MoT) planning support and to provide the tools to improve the MoT decision making capabilities. In this case, the “tools” are accurate, timely information to support the design of policies, and to be able to monitor the effect of those policies. The provision of such accurate and timely information will in part be through the use of updated computer hardware and software to store relevant data, and to allow immediate and flexible access to that data in various forms of useful, current, and dependable management and planning information.

1.1.2 Study contents

The Computer report concentrates on the computer hardware and software needed to accomplish a more modern and automated information system for MoT’s use as a central data repository. The objectives are as follows:

- ❑ To define the environment and technology for basic MoT office automation.
- ❑ To explain the local and wide area network technology to be used, and the best approach to its implementation.
- ❑ To detail the new computers to be installed and the existing computers to be replaced, and the purpose of each.
- ❑ To recommend the database to be used and the requirements necessary for its proper implementation and adoption into the Ministries’ needs.
- ❑ To recommend office automation software and its uses.
- ❑ To outline the options and requirements for implementation assistance, training, and long-term support, both technical and user based.

1.2 TECHNICAL ISSUES

1.2.1 Current technology fundamentals

WHAT COMPUTERS ARE – AND ARE NOT

In order to better understand the first and most important aspect of modern computers and computer technology, it is best to put computers in terms of manual processing. There is

virtually nothing that can be done by a computer or computerized system that cannot be done manually. All computer systems and applications are designed to store text, graphics, and any other form of information that can be represented in digital form, to perform a specific set of functions with that data in a prescribed step-by-step manner, and to output data in a usable and useful form. This is the same process that all manually processed data goes through, regardless of the type of data or the purpose of the process. Computer systems cannot give the MoT anything that could not be provided by a strictly manual process done by hand.

What a well-planned and properly implemented computer system *can* give the MoT is greater *efficiency* and *effectiveness* over the manual process. As one example of the efficiency typically gained, consider how the MoT border traffic information gets to its end result; that result being any of several statistical reports produced by MoT personnel. When a truck stops at a weigh bridge at the border, a person fills out a form with all pertinent information about that truck and its load. At some time after that, someone has to either ship the all of the forms for some period of time to the MoT offices in Lilongwe, or someone has to go to the border to pick them up. At the MoT, someone types the data from each form into a computer file. That person or others subsequently copy the file to several other files on that computer and on other computers. Someone then uses each of these copies to combine with other data that they summarise and sort. That result is then used to create any one of various reports. Copies of the data are written, re-entered, handled, and re-processed by a number of different people.

Consider the efficiency of a similar process whereby the data is collected at the weigh bridge and entered into a computer that could print the detail of that transaction on the spot, and at the same time was immediately available to programs that could combine and summarize that transaction automatically, and make the results available to anyone in the ministry who needed it, in what ever form they needed.

Such *efficiency* is not only less costly, but because the data is handled by only one person, the person at the *source* of the data, there is much less chance of the data being in error.

Consider also the *effectiveness* of having information, any information, on a timely basis. All information processing, whether computerized or not, has the same basic purpose; to put the right information in the hands of the right people when they need it. If revenue is not collected, and expenses are not paid, and decision support information is not available when a decision is needed, then the effectiveness of any organization, including the MoT, is diminished. Even relatively simple information can be critical. For instance, it does no good to find out that you were supposed to be a part of an important meeting that has already taken place.

CENTRALIZED V/S DISTRIBUTED STORAGE AND PROCESSING

The original computer servers were the first mainframes. Every application, every database, and every file was stored somewhere on a mainframe, which could be considered like a very intelligent server. The various underlying reasons for allowing computers to communicate were the same as in today's PC networks. Networking allows information to be shared

quickly and easily. Sharing information accelerates the process of obtaining or creating knowledge, and knowledge is needed for all MoT policy decisions.

Modern networks, even many mainframe networks, are based on the concept of *clients* and *servers*, both attached to the network. Clients are the desktop computers, the PC's, that users rely on for their output. Clients do most of the processing related to the presentation of information. A server is the repository of information and provides processing-intensive services to their clients. This puts some of the more demanding networking functions on servers, which can be especially configured to take care of these functions effectively, and frees up client PC's to spend their processing power in other ways.

This is one of the keys to establishing and running an efficient client/server network at the ministry. If a majority of the clients on the network are using their processing power for the same function, then that function can be moved to the file server. The clients will still have access to the functions and its benefits, but they don't have to do the required processing. A specially configured file server does the processing.

Here is a short list of some basic MoT file server functions:

- Repository for application programs,
- Repository for data,
- Repository of network operating system,
- Manager and storage for directories and files,
- Manager for the network.

CURRENT PC TECHNOLOGY

For an average U.S. price of under US\$2,000 (KM84,000), the personal computer (PC) of today provides more data storage and more processing power than the biggest multi-million dollar mainframe computer of only ten years ago. Every month, new and faster computers are introduced at a rate where the speed and capabilities of computers doubles on average every 16 months. Although this results in computer systems becoming obsolete within only a few years of their acquisition, this rate of improvement has benefits to this MoT database project that greatly outweigh the drawbacks. Chief among those benefits is the ability to store and present graphic information, as well as to present user interfaces that are graphic-based, or GUI, such as the now familiar "Windows desktop" icons, pull-down menus, and live action on-demand user assistance. All of this helps to address the various training and support issues that are critical to the success of this system.

For the MoT, another of the advantages of the current state of computer technology is the ability to even consider creating any sort of *meaningful* transportation database. Five years ago, cost and complexity would have prohibited the implementation of such a system. The high demand for systems of this sort has resulted in certain sets of standards to emerge in system interoperability, database concepts, and general application functionality. What this means for MoT is that the system selected and implemented today will have enough flexibility to perform a very wide number of tasks, and still co-exist with other systems in other facilities in Malawi and in the region without first knowing all of the specifications of those systems.

Within five years, it is likely that the modern up to date system being proposed for the MoT will be obsolete. That does not mean that it will in any way be unusable or ineffective. It means that within five years the quantifiable justification for upgrading or replacing this system will probably be there. This likelihood has been taken into consideration as the MoT system brand, size, speed, and other configuration recommendations were formed to help insure that this system is as sound of an investment as is possible in such a fast changing setting.

Today, the single biggest influence over the direction of computer hardware, software, and communications development is the internet. Five years ago, most people had never even heard of the internet. Today, it provides instant and continuous communications capabilities to people, businesses, and governments world-wide. For now, hardware and software support are the two biggest reasons why the MoT needs internet access, but within the next few years it is likely to have other, more dramatic effects and potential benefits for the MoT.

DATA STORAGE AND ACCESS

At the core of every computer system, whether mainframe or PC, whether local or the biggest wide-area network of them all; the internet, is the need to store and retrieve data. Modern PC's can perform millions of arithmetic calculations every second, but the real power lies in its ability to store millions of characters, or bytes, of data, at very high rates of speed, and to locate and retrieve that data almost instantly, and with complete accuracy.

There are a number of data storage technologies in use today, but the only commercially available means of rapid data storage and retrieval remains what is often called "Disk" or "Hard Disk". Other forms of data storage, such as tape, CD, and most recently the next generation, super-high capacity CD replacement called DVD, are good for specific functions such as off-line backup in the case of tape, and mass data archiving in the case of CD and DVD. However, none of these storage systems is designed for repeated rapid storage and retrieval, which is necessary to support the MoT database environment.

The most easily overlooked element in data storage and access is the issue of whether or not data that is stored is complete and accurate. There is a familiar saying associated with computers that is completely true; "*Garbage in, garbage out*". Simply put, no computer system can improve on the quality or accuracy of the data that is entered into it. Computers can often help to spot potential errors, but if incomplete or inaccurate information is stored, then incomplete and inaccurate information is what will be produced. For this reason, *the process of getting good, timely data into the system is far more important than the system itself*. Audit and control measures must be developed and enforced that help insure proper data collection and entry for all data sources, whether it is the manual batch entry of survey sheets, or the recurring importation of complete data bases from NSO, SATCC, and others.

SECURITY

Although any loss of computer hardware can be difficult and costly, the real value of the MoT computer system is the data stored in it. Any substantial loss or corruption of data can be devastating. In order for the system to have any measurable effect on MoT, the people using the system must learn to rely on it. If the system becomes only a backup to data that is

still maintained and used manually, then the purpose of the system has been defeated. For these reasons and others, several well-structured measures need to be put in place to insure that the data is protected.

≠ *Tape backup*

First is an absolute need to faithfully keep tape copies of everything in the system. Such complete copies should be made at least once each week. Additionally, critical dynamic files should be copied separately either daily, or each time the data in any of those files is in any way changed. The most recent copy of each backup tape should be kept at the ministry in a locked, fireproof safe. A place to securely store tapes away from the ministry building should also be established, then when new copies of data are created and stored in the safe at the ministry, the previous copy from the safe is taken to the off-site location. This provides the only secure method of guarding against complete data loss.

≠ *Privacy*

Second is the consideration of sensitive data. Most data that MoT is likely to store is public data, therefore sensitivity is not an issue. However, some accounting and human resource data is very sensitive, as are many letters, documents, correspondence, and other data items. Data stored on the server can be stored in public, or “shared” folders, or can be stored in private folders that only one specific user or one department has access to. Specifically which users require access to what information will have to be determined by the system administrator by working closely with the various users and departments during system installation, and may require additional periodic scrutiny and modification.

≠ *Public access*

Third is the issue of public access. Gone are the days when the data in a computer could be protected from access by locking the door to the room with the computer. All modern and effective computer systems require that they communicate and share information with other systems, that they have access to the internet, and that they are accessible from any number of geographic locations other than the site of the physical system. Currently in Malawi there are limited communication capabilities, but this is changing rapidly. Already, just in the last few years, access to the internet from users in Malawi has grown substantially, and the internet forms the backbone of today’s communication environment.

Public access can be controlled through the use of a firewall. A firewall takes many forms, but in essence what it does is it sits between the computer system and the phone system. Only authorized users can get through it to gain full access to the system. The firewall can be programmed to allow public access to only certain areas in the system, and can limit people to have “read-only” access to the data that is made publicly available. As with the issue of controlling data access within the ministry, the specific design and configuration will have to be reviewed regularly.

No one person can decide how MoT data security should be designed. Rather, all of these and other security issues need to be discussed and reviewed by a number of people. A system security committee should be established *before* the system is installed, to meet and

to review these and other security related topics, and to set the policies and design the structures for security. This committee could consist of the same people on the recommended transition oversight committee, or could be a separate group of people dedicated exclusively to security. If separate, it should report to the transition oversight committee until the initial installation and implementation is complete. The system security committee should meet monthly to insure that all security procedures are being followed, and to review and amend the security plan as needed.

1.2.2 MoT existing computers and computer systems

#	Office	Department	Primary user	CPU	O.S.	Main Application	Main application use
1	Statistics	Trans planning	E Chiwinga	IBM PS2-70	DOS	Dbase IV	Border traffic reports
2	Satistics	Trans planning	E Chiwinga	Acer Entra	W-95	Dbase 5	Transfer from PS2-70
3	Statistics	Trans planning	R Kamanga	IBM PS2-70	DOS	Dbase IV	Entry of border transport data
4	Accounts	Accts. Div	P Katanga	Acer Entra	W-95	Lotus 123	Monthly expenditures & collections
5	Cash	Accts Div	P Katanga	Acermate 486/g	W-95	Data Ease	Check reconciliation
6	Director of Planning	Trans planning	T Kaunda	Acer Notebook		WP 6.0 Lotus 123	Concession planning General correspondence
7	Sr. Planning Officer	Trans planning	Mulebe	Acer Notebook			
8	Planning	Trans planning	communal	Power Net	W-95	Lotus 123	Various
9	Planning	Trans planning	G Muwalo	Acer Entra	W-95	Explorer	Send & receive email
10	Transport econ.	Trans planning	Nundwe	AST 4/33	DOS	Lotus 123	Various reports
11	Rural motorized transport	Trans planning	B Manda	ICL 25mhz	W 3.1	Lotus 123	Unknown (new to position)
12	Sr. trans planning officer	Trans planning	S Chikapusa	Acer Entra	Win-95	WP 6.0	Letters, memos, etc.
13	Sr. Deputy Secretary	Administration	Chitimbe	AST Notebook			
14	Principle Secretary	Executive	Vareta	McIntosh			
15	Sr. Deputy Secretary	Administration	M Bizeki	Acer Entra	W-95	WP 6.1	Letters, memos, reports
16	Principle Secretary	Executive	Msefula	IBM 130-100DX4	W-95	WP 6.1	Various
17	Sec to the Minister	Executive	M Gwaza	IBM 130-100DX4	W-95	WP 6.1	Various
18	Accounts	Accts. Div	P Chirwa	Acermate 486/g	W-95	Lotus 123	Various accounting spread sheets
19	Main Accounts	Accts. Div	C Kalongosola	Acermate 486/g	W-95	Lotus 123	Expenditures spread sheet
20	Accounts	Accts. Div	P Katanga	Unisys	DOS	Lotus 123	Backup applications
21	Secretary	Administration	L Sisy	Acer Entra	W-95	WP 6.0	Various letters, memos, etc.

1.2.3 Data storage requirements

Data storage at the MoT will exist in two basic forms; individual user PC's, and the new network file server. In general terms, information that is specifically unique to one user, especially where that data or information is being created or extracted for temporary use, can be stored on that user's PC. Otherwise, all data collected, stored, and managed by the ministry, whether intended for use by a number of people or whether for one individual's use only, should be stored on the file server.

Source data collected by the MoT should be kept available on the file server for a minimum of three years, with five years the ideal target. Whether data should be kept on-line longer than five years will depend on its perceived usefulness, and on the storage capabilities and technologies in place at that time. Therefore, the length of data retention past five years can not be determined until later in the five-year time frame.

The *usable* size of the random-access data storage (disk) available to the network file server (after subtracting the raid-5 requirement from the *total* space) needs to accommodate the sum of the average static data plus the sum of 5 years average dynamic data, including dynamic data from other regional databases such as SATCC, plus 25% for keys, indexes, and data dictionaries, plus the storage of user data (spread sheets, text documents, query definitions, images, etc.), plus 3 times the largest estimated file, plus system and application software libraries, and have guaranteed at least 25 percent free space at the end of 3 years. This results in an estimated space requirement of from 25 to 50 gigabytes, therefore 50G is recommended for the MoT file server disk.

1.2.4 Database software considerations

At the core of the requested outcome of this project is the creation of a transportation database. While considering various database options, it is important to consider what a database actually is. A database is a collection of electronic files stored on a computer or a group of computers. These files, or as they are sometimes called "tables", exist exclusively for the purpose of keeping records so that information can be retrieved from them whenever needed. In general terms, a database is very similar to a typical manual filing system with various drawers, folders, and indexes to help properly organize, store, and retrieve collections of documents containing various types of information.

Maintenance of a computer database is accomplished by a database management system, also referred to as database software. There are a number of good, commercially available database management systems, among them are systems called dBASE, Access, FoxPro, Informix, Oracle, and others. The fundamental purpose and method of data management of each is similar, with the differences being the various built-in functions, the design of the user interface, the flexibility, the volume of data that each is designed to handle effectively, the built-in security options, the reliability, and the level of compatibility with other software and systems.

Perhaps the most important criteria for selecting the proper database software for the MoT is the availability of support. Support is needed in two key areas; database design and problem resolution. Database software is similar to other general-purpose software, such as word processing or spreadsheet software, in that by itself, database software has no real form or structure. It is an "engine" for powering the database, but the database "engine" must be

designed and built before it can be used. Once built, data must be either manually entered into it or transferred and formatted electronically.

After the initial loading of data, the database must be maintained as source data changes and new data becomes available. Various forms of data extraction and information retrieval need to be performed on an ongoing basis, since access to information is the primary purpose of having a database. Also, various issues and problems will arise on a somewhat regular basis, regardless of what system is used or how well it has been designed and implemented, therefore having qualified technical support available as needed is critical. Training is available to learn how to perform all of these functions.

1.2.5 Office administration and management software

The intention of office automation and management software is to accomplish two objectives. The first objective is to give all computer users the ability to generate spread sheets and word processing documents. The second is to provide tools that allow easier communication and organization between the various individuals and departments within the Ministry. There are a number of flexible, popular software packages available today that accomplish both of these objectives with a reasonable amount of reliability and user-friendly interfaces.

In selecting one package that will suite the environment at the MoT, it is important to consider the availability of training and support as the primary factor, since any one of several different solutions would suffice. Offerings such as Corel Perfect Office, makers of Word Perfect, are perfectly serviceable. However, the Microsoft Office-97 application suite is recommended for the following reasons:

- It is currently the most used office package in the world, which means that training and support is widely available, and is likely to remain so for the foreseeable future.
- It creates the highest level of consistency between the applications and the operating system, Windows NT.
- It results in the lowest number of support vendors required.
- The simplicity of Access, its database application, will aid in the transition to the new system.

This package includes the word processing application Word, the spreadsheet application Excel, and the mail application Outlook. All of these interface well with each other and with the operating system. This package also includes the application PowerPoint for creating graphic presentations.

1.2.6 The Local Area Network (LAN)

The main purposes of the LAN is to give instant access to the database to everyone who needs it, to connect all of the users in the office for internal e-mail, to provide a single storage point for data back-up, to give everyone who needs it access to the internet, to provide a single platform for software installation, modification, and upgrading, and to allow for centralized system administration.

There are several PC operating systems capable of managing the network. The two most widely used today are Novell and Windows NT. NT now has the largest installed base. It is the opinion of the project data specialist and others that the NT user interface is more

intuitive, and that in general the underlying NT software is easier to manage with less training than with Novell. It is therefore recommended that the LAN be controlled by Windows NT server running on the file server, with Windows-NT client running on each of the user PC's. The basic LAN communication topology should be fast Ethernet 100BaseTX running through category-5 wire connecting network interface cards (NIC's) in the file server, user PC's, and the work-group printers through a set of 3Com intelligent Hubs.

1.2.7 Wide Area Networking

For the sake of this report, Wide Area Network (WAN) is referring to any of several currently available and future connections of the MoT LAN to other LAN's and/or other systems, including the internet. Connectivity to the internet will initially be through a conventional dial-up modem connected to the public telephone system through a firewall. The firewall insures that there is no unauthorized access to the MoT LAN from outside of the Ministry.

Remote connection to other PC's and systems for the purpose of file transfer will be accomplished through a conventional point-to-point switched (dial-up) connection. As Road Traffic, the NSO, and others move into Windows NT with internet connection, virtual private networks (VPN's) can be established that allow system access and file transfer through conventional internet connections.

The internet-based VPN has the added advantage of being able to allow many service and support functions to be performed on the MoT LAN from any qualified provider in any location in the world. This is a viable option for some of the database and application design that MoT will require at the time of initial system installation, and later to satisfy the changing needs of the ministry. This will require a permanent internet account through any of the available Internet Service Providers (ISP's) in Malawi, such as MalawiNet.

Other methods of WAN connection may have to be considered as co-operation between the various Ministries, departments, and private companies grows in order to accommodate the needs and capabilities of each entity with which the MoT will share data.

1.3 RECOMMENDATIONS

1.3.1 Overview

The best way to insure that the MoT is capable of maintaining a transportation database capable of providing the decision support information required is to create an integrated computer network utilizing a network file server that everyone who requires use of that data can access to extract data on demand as necessary. The result of the hardware and software listed below will create such an information environment.

The key to the success of this system will be in the provision of long-term user and technical assistance, as well as assistance and training during the initial installation, configuration, network design, and data base design.

1.3.2 Computers

1.3.2.1 Locations, purposes, and types recommended

Many of the existing PC's use a technology that is not practically compatible with the rest of the system being recommended. Those PC's will be retired and replaced. All other existing PC's are being utilized, and can and should remain a part of the new system with the addition of a LAN NIC adapter to each.

A combination of adding twenty new PC's, and two laptops, shifting two of the existing computers, retiring others, and adding eleven LAN adaptors (NIC's) to the remainder of the PC's accomplishes the following

- An in-service total of 32 PC's plus one file server.
- Six of the PC's (lines 1, 3, 10, 11, 14, & 20 below) will be pulled from service and retired.
- All remaining PC's currently in use in the MoT headquarters management unit will be upgraded to Windows-NT, will have a LAN NIC added, and will connect to the new file server.
- Three computers will be added to the human resources department, which currently relies entirely on a manual non-computerized system (lines 23 – 25 below).
- Those currently using only a laptop (lines 6, 7, & 13 below) will be given desktop units compatible with the rest of the network, therefore gaining its benefits.
- The functions of the positions that will be filled soon through transfer from MoW and MoT expansion (lines 26 – 35 below) require PC's and LAN connectivity.
- The two new laptops will provide user flexibility and can be used either as desk top units or when staff is travelling on official business.

#	Office of	Department	Current User	Current CPU	Recommended Disposition
1	Statistics	Trans Planning	E Chiwinga	IBM PS2-70	Out; already replaced
2	Statistics	Trans Planning	E Chiwinga	Acer Entra	Replace NEW (to H/R below)
3	Statistics	Trans Planning	R Kamanga	IBM PS2-70	Replace NEW
4	Accounts	Accts. Div.	P Katanga	Acer Entra	(same, add LAN)
5	Cash	Accts. Div	P Katanga	Acermate 486/g	(same, add LAN)
6	Dir. of planning	Trans Planning	T Kaunda	Acer Notebook	Add NEW
7	Sr Trans Ofcr	Trans Planning	Mulebe	Acer Notebook	Add NEW
8	Planning	Trans Planning	Communal	Power Net	(to data clerk, add LAN)
9	Planning	Trans Planning	G Muwalo	Acer Entra	(same, add LAN)
10	Trans Econ	Trans Planning	Nundwe	AST 4/33	Replace NEW
11	Rural M.T.	Trans Planning	B Manda	ICL 25mhz	Replace NEW
12	Sr Trans Plan	Trans Planning	S Chikapusa	Acer Entra	(same, add LAN)
13	Sr Deputy Sec	Administration	Chitimbe	AST Notebook	Add NEW
14	Principle Sec	Administration	Vareta	Macintosh	Replace NEW
15	Sr Deputy Sec	Administration	M Bizeki	Acer Entra	(same, add LAN)
16	Principle Sec	Executive	Msefula	IBM 130-100DX4	(same, add LAN)
17	Sec. to the Minister	Executive	M Gwaza	IBM 130-100DX4	(same, add LAN)
18	Accounts	Accts. Div.	P Chirwa	Acermate 486/g	(same, add LAN)
19	Accounts	Accts. Div.	C Kalongosola	Acermate 486/g	(same, add LAN)
20	Accounts	Accts. Div.	P Katanga	Unisys	Out; not needed
21	Secretary	Administration	L Sisya	Acer Entra	(same, add LAN)
22	Sr Trans Ofcr	Trans Planning	S Chisale	(none)	Add NEW
23	Human Res.	Administration	A Whayo	(none)	Give Acer Entra from Statistics, add LAN
24	Human Res.	Administration	W Mitembo	(none)	Add NEW
25	Human Res.	Administration	K Bodali	(none)	Add NEW
26	Dep Ch Trans Planning Ofc	Trans Planning	(transfer/exp)	(none)	Add NEW
27	Princ Trans Planning Ofc	Trans Planning	(transfer/exp)	(none)	Add NEW
28	Princ Trans Planning Ofc	Trans Planning	(trans/exp)	(none)	Add NEW
29	Tran Plan Ofc	Trans Planning	(trans/exp)	(none)	Add NEW
30	Tran Plan Ofc	Trans Planning	(trans/exp)	(none)	Add NEW
31	Tran Plan Ofc	Trans Planning	(trans/exp)	(none)	Add NEW
32	Tran Plan Ofc	Trans Planning	(trans/exp)	(none)	Add NEW
33	As statistician	Trans Planning	(trans/exp)	(none)	Add NEW
34	Data Prep	Trans Planning	(trans/exp)	(none)	Give Power Net from planning communal
35	Data Prep	Trans Planning	(trans/exp)	(none)	Add NEW
36	Data process			(none)	File server – NEW

1.3.2.2 Operating systems and networking

The file server will utilize Microsoft NT server 4.0. Each of the new PC's will be installed with Microsoft NT 4.0 client, and the remainder of the PC's that are in the system currently utilizing Windows-95 will be upgraded to Windows-NT. The firewall will be built using Proxy Server. Centralized system management will be accomplished with the aid of Hyena.

1.3.2.3 Peripheral equipment

MONITORS

17 inch monitors are fast becoming the PC based quasi-standard for business text-based processing. In order to provide for the most efficient use of the multi-tasking Windows environment and to allow a large amount of data to be displayed and easily seen by the users, 17 inch VGA monitors should be supplied with each new PC and with the file server.

PRINTERS

There are a few printers now in service at the MoT that can continue to be utilized in those offices where immediate access to low volumes of printing is needed. As those printers age and come out of service, it will probably not be necessary to replace them. In order to provide a balance of the needs of low volume on-demand printing with high volume batch printing, the recommendation of this study is to create a group of five identical medium-duty printers in a workgroup configuration.

Rather than necessarily assigning a printer to each department or office, these five printers can be strategically placed at five different locations within the ministry building where anyone can have ready access to them. Users can then direct their printing to any of the printers as needed.

One high-quality H.P laser printer was recently purchased on behalf of the MoT, and is of the same type recommended for a workgroup. To maintain consistency, it is recommended that four more of the same printer be purchased to create the group of five to form the printing workgroup. These printers are of a medium speed and duty cycle and are likely to perform well for all anticipated MoT printing needs. Also, the consistency of having five of this same model printer creates the best environment for managing printer supplies and maintenance.

POWER SUPPLIES

All PC's and the file server require reliable AC power that is consistent within this equipment's power requirements. Therefore each one requires that it is connected to some form of uninterruptable power supply. It is especially critical that power to the file server be consistent and reliable, and that in the event of a power outage, power remains to the file server long enough for it to be shut down in an orderly manner. There are two different configurations that should be considered:

Option-1. Purchase enough low power battery backup units to protect all of the user PC's with one unit physically located near each PC, plus one good

quality combined power conditioner and battery backup unit, or Uninterruptable Power Supply (UPS) for the file server.

Option-2. Purchase two large UPS units that feed power wiring that would be run throughout the ministry building, and run all PC's through the two units. Each of these two units would be large enough to supply power to most of the system in the event of a UPS failure.

USAID should get quotes for both UPS hardware configurations, plus get a quote on wiring the building for option-2. If the total cost of option-2 is no more than 25 percent greater than option-1, then option-2 should be followed. Otherwise, option-1 should be followed.

1.3.2.4 Installation and maintenance

Installation will require that a logical LAN topography be designed, and the MoT headquarters building be physically wired with category-5 cable from each user PC and each workgroup printer to the LAN hubs. The initial configuration of each PC, the installation and configuration of the file server, and initial verification of the entire network will have to be contracted to a qualified technical specialist or technical services provider. The bid for installation service must include the cost of providing all necessary category-5 cable and connectors, and the installation of both.

Once system installation is complete, the same installation firm must be able to provide initial training to the users on the use of PC's in a network environment, and be able to remain on site until any initial system problems have been corrected.

1.3.3 Database

1.3.3.1 Software

The most ambitious, and perhaps most important aspect of the new system is the establishment of a comprehensive transportation database. The successful implementation of the recommendations in section-2 of this study should result in a substantial influx of useful data to the MoT. To store and retrieve that data on the file server in an effective manner requires the carefully planned implementation of the proper database management software.

It is critical to the success of the database implementation that design and support expertise be readily available to the MoT. Because of the relative lack of trained and experienced experts in this field in Malawi, the use of database software that is consistent with other databases in use in Malawi is important, especially as it relates to other Government ministries and agencies. The National Statistics Office is utilizing Oracle as their primary database management software. The Road Traffic Department is currently planning implementation of a licensing and registration system based on Oracle. The Ministry of Finance is sponsoring an inter-Ministerial financial system called IFMIS that is also based on Oracle. Other government bodies are also moving toward the use of Oracle. Because of the current and planned availability of support and training for Oracle, and to help create a level of consistency throughout government, it is the recommendation of this study that Oracle be installed with the initial system, then implemented in the

long-term at the MoT at such time as adequate training and preparation is complete.

Oracle is a very comprehensive and powerful package. Its greatest advantage over simpler database software such as dBase, FoxPro, or Access is that there is no practical limitation to the size or complexity of the database that can be developed. Functions and processes from the simplest queries to complex integrated systems can be built utilizing Oracle.

The biggest drawback to Oracle is that because of its inherently comprehensive nature, Oracle is *not* an easy-to-use and user-friendly *off-the-shelf* package. To implement Oracle will require time for careful planning and database design, and the acquisition of a new set of technical skills that does not now exist within the MoT. Proper implementation will take training, planning, and time, and falls outside of the scope of the initial donor recommendations.

Because of this, a two phase approach is needed:

PHASE-1 Install and utilize Microsoft Access as the database management software at the time of initial system installation. Access is already included in the Microsoft Office-97 suite recommended in this study. Access is easy to use, and training is readily available. Many users of Access have been successful in creating and maintaining simple databases using only self-help training material, and in a very short period of time.

Training should be provided for two individuals who will be given primary responsibility for processing Access requests and for overall system administration. Access training should also be made available for any user who utilizes the database and who desires to be able to produce their own output from the database.

At start-up, Oracle-8 Personal Edition will also be installed. At some point after initial system installation, MoT should begin providing the two technical support individuals with formal Oracle training. This training should be ongoing until such time as these people reach at least a basic level of proficiency in the various Oracle concepts.

PHASE-2 When training of the two MoT individuals is at a sufficiently proficient level, and with the direct assistance of outside expertise as described in section 3.3.3.b below, the contracted Oracle expert(s) and the trained MoT personnel will design and implement a comprehensive Oracle-based database management system. It is hoped that the timing of this will loosely correspond with the MoF IFMIS project, which should help insure that the various MoT planning tasks can be done in loose co-ordination with, and where possible taking advantage of, the various IFMIS efforts.

Once this is accomplished, most pertinent data in the Microsoft Access database will be transferred to the Oracle database. Oracle based applications

will then be designed and implemented that the average user at the MoT can easily understand and use to meet their various requirements.

1.3.3.2 Design considerations

Installation and initial Microsoft Access database design will have to be performed by a qualified Access expert. With the satisfactory conclusion of the Phase-1 Microsoft Access design and implementation, the advantage in selecting the Oracle expertise to be contracted for phase-2 should be given to the same firm. Familiarity with the then-existing MoT Access database will aid in the design and implementation of the Oracle database. Care must be taken to review the source data specifications and MoT information requirements around which the system will be designed.

As with any good database design, it is important to normalize files as much as possible. This means in essence that data should not be redundant. Only those data elements that are necessary to link each of the different tables should exist in more than one table. This also means that where multiple occurrences of similar data exist, especially where the number of occurrences related to one record can vary, each occurrence should be stored as a separate record or row. This allows for greater flexibility, often uses less disk storage space, and most fully utilizes the power and capabilities of the database.

1.3.3.3 Support

Full-time on site support will be required for user application assistance and system administration for at least the first month after initial system installation. That same support supplier must be available on an on-demand basis for an additional three months after that, and must be available as needed periodically for the remainder of the first year of operation. Additional support for all Microsoft products is available through the internet. This valuable support resource should be utilized to its fullest even during the period of on-site support. In this way, the MoT will gain familiarity with the process, should gain some level of self-sufficiency, and should be in the best position to continue to keep the system running and resolve common problems.

1.3.4 Office automation

The intention of office automation and management software is to accomplish two objectives. The first objective is to give all computer users the ability to generate spread sheets and word processing documents. Both of these functions are in wide use at the MoT today, and provide a very flexible work environment, even though training is needed to maximize the potential of these functions. Word processing provides the means for creating virtually any text-based output, and is already a widely accepted office automation tool. Spread sheet software allows any size and form of a table to be created, modified, stored, merged, and printed, and allows the user to set up formulas and macros for automatic calculation of any data within one or more spread sheets.

The second objective is to provide tools that allow easier communication and organization between the various individuals and departments within the Ministry. The most important tool is the ability to send and receive email messages within the ministry. The experience of thousands of other companies and agencies around the world can easily be applied to MoT,

which indicates that once MoT users become accustomed to using local email for messages, inquiries, notification of meetings and so forth, there will be a natural improvement in overall ministerial effectiveness as a cohesive unit.

1.3.4.1 Office suite software

Because of the power and widespread acceptance of the Microsoft office suite, it is the recommendation of this study that the MoT utilize Microsoft Office-97 Professional Edition. A newer version, Microsoft Office-2000, will soon be available, but it is better for the MoT to use the current version, Office-97, that is already a proven and stable software suite with widely accessible training and support. The Office-97 Professional Edition package includes the word processing application Microsoft Word, the spreadsheet application Excel, and the mail application Outlook. All of these interface well with each other and with the operating system Windows NT. Users at the MoT of the applications Word Perfect and Lotus 123 should find the transition to the Microsoft Word and Excel applications relatively easy, since the applications all have a similar “look and feel”.

This package also includes the application Microsoft Access, a database product that will be utilized exclusively during phase-1 of implementation, and the application PowerPoint that allows for the creation of presentation graphics.

1.3.4.2 Accounting software & IFIMS

The accounting software and methodology currently in use at the MoT are not up to the standards that the MoT needs to run efficiently. However, with the immanent installation of the Malawi Integrated Financial Information Management System, it is best to not change the accounting software at this time. Still, the accounting department PC's will be connected to the MoT LAN to take full advantage of the rest of the benefits of the LAN environment.

1.3.5 Communications

1.3.5.1 Internet access

An full internet access account must be established for the MoT, and be available at the same time that the system is first installed. The primary purpose is to provide on-line user and technical assistance from the software suppliers who themselves provide 24 hour internet-based support. This internet account can be a conventional dial-up account for periodic use. Access to this account will be monitored by the system administrator.

1.3.5.2 WAN integration

For the sake of this report, Wide Area Network (WAN) is referring to any of several currently available and future connections of the MoT LAN to other LAN's and/or other systems, including the internet.

Because of the state of the computer systems with which the MoT will share data, and because of the lack of a reliable telecommunications infrastructure to all points

in Malawi, the transfer of computer data or files will have to be accomplished by copying that data onto diskette, then physically transferring that diskette to the other system.

As soon as computer capabilities and communications permit, remote connection to other PC's and systems for the purpose of file transfer will be accomplished through a point-to-point switched (dial-up) connection manually initiated and coordinated between the MoT and the other entity. As Road Traffic, the NSO, and others move into Windows NT with internet connection, virtual private networks should be established that allow system access and file transfer through conventional internet connections. Other methods of WAN connection such as frame relay may have to be considered as co-operation between the various Ministries, departments, and private companies grows in order to accommodate the various needs, designs, and capabilities.

1.3.6 Training and support

1.3.6.1 User training

Initial training of all users on Microsoft Word, Excel, and Outlook (approximately 22 – 25 people) should be provided by group and individual instruction. Each user should be provided with no less than the equivalent of 80 hours of combined lecture and hands-on training. The provision of this training should either be negotiated with the system installation provider, or separately by a qualified Microsoft trainer. User reference manuals and tutorials need to be supplied to all users to supplement that training.

In addition, a user-oriented self-help tutorial package for Microsoft Excel should be purchased, and access to it provided to all users who wish to take advantage of it. In-house assistance for this self-help training should be provided by the two MoT technical staffers, the network system administrators, who themselves will have gone through more comprehensive Access training.

1.3.6.2 Technical training

There should be two people on the MoT staff who are technically trained and qualified as network system administrators. Their responsibilities will include, but not necessarily be limited to;

- Insuring that the server is functioning during all business hours.
- Performing full server file backup at least weekly.
- Resolving equipment or server outages or performance degradation.
- Adding, moving, and replacing all LAN attached equipment.
- Assisting with user office application problems, issues, and training.
- Monitoring system usage and system security.
- Assisting users with database information retrieval, and assisting with application design and data queries.
- Processing user requests for all database functions where those functions are beyond the abilities of the users to perform themselves.

- Acting as liaison to co-ordinate processes, procedures, standards, and technology planning with other ministries, agencies, and private companies.

1.3.7 Hardware and software to be acquired

To implement the above recommendations, the following specific hardware, software, and services will need to be purchased. Configuration, training, maintenance, and support will all be enhanced by having as much equipment and software duplication throughout the system as is feasible. As much as possible, consistency throughout the final selection of hardware and software should be strictly observed.

There are several different manufacturers of high quality PC's and servers that would be suitable for the MoT system, and each manufacturer makes several different models that meet the minimum requirements as set forth in this study. Since new models are being introduced at a rapid rate, specific models available as of this writing may not be the current offerings available when bids for procurement are received.

Therefore, in the case of the PC's, laptops, and the file server, specific models within brands have not been recommended. Instead there is a list of preferred manufacturers, and the minimum specifications of the PC's to be purchased. Any model from any of the listed manufacturers that meets the minimum specifications should be acceptable and therefore should be considered for purchase.

Although PC's of one brand will interface with a server of another, it is *strongly* recommended that the PC's and the file server be of the same manufacturer and from the same supplier.

RECOMMENDED PC AND FILE SERVER MANUFACTURERS

- IBM
- NCR
- Compaq
- Hewlett Packard

PC AND FILE SERVER SPECIFICATIONS (minimum configuration)

Specification type	PC's	File server
Quantity	20	1
CPU type	Pentium-II	Pentium-II or Pentium-III
CPU clock frequency (min)	350 MHz	400 MHz
Math Co-processor	Yes	Yes
Cache (min)	256	1 MB
Main memory	64 MB	256 MB
Primary Bus system (min)	>30MB/sec	>200MB/sec
Bus Slots (min)	2	6
Network interface	802.3 LAN on	802.3 LAN on

	primary bus	primary bus
Network connection type	RJ-45	RJ-45
Network connection speed	100 Mbps	100 Mbps
Network wiring type	100 Base-TX	100 Base-TX
Hard disk capacity (min)	6 GB	50 GB
Disk redundancy / protection	(none)	RAID-5
CD ROM	>8X	DVD
Tape drive	(none)	24GB DAT
Floppy disk	3.5"	3.5"
Speakers	Optional	Optional
Monitor	17"	17"

LAPTOPS

Specification type	Laptops
Quantity	2
CPU type	Pentium-II

NETWORK PERIPHERALS

PC network hub	Value
Quantity	4
Network interface	802.3 LAN
Port connection type	RJ-45
Number of ports per hub	12
Stack / cascade ability	Yes
Dedicated cascade port	Optional
Speed	100 Mbps
Wiring type	100 Base-TX
Protocol	Fast Ethernet
Suggested manufacturer	3Com

PC network interface (NIC)	Value
Quantity	11
Network interface	802.3 LAN
Port connection type	RJ-45
Wiring type	100 Base-TX
Protocol	Fast Ethernet

PRINTERS

Printer specification	Value
Quantity	4
Manufacturer	Hewlett Packard
Model	4000TN
Print speed (max)	17 pages per minute
Duty cycle	65,000 pages per month
Network interface	Parallel PC Serial Ethernet Din-8 MAC
Resolution (max)	1,200 DPI
Duplex option	No
Onboard memory	8 MB
Emulations/Languages	PostScript Level 2
Printer peripheral specification	Value
Quantity	1
Manufacturer	Hewlett Packard
Model	600N
Description	Jet direct ethernet print server (NIC) for existing H.P. 4000T printer

COMMUNICATION

Modem specification	Value
Quantity	2
Modem speed	56K
Type	V90
Communication standard	V.32 bis, V.42 bis
Network interface	RS-232C
Software	Drivers for X.25 network software.

POWER PROTECTION: Option-1 (see 1.3.2.c *POWER SUPPLIES*)

Unit specification	Value	Value
Quantity	1	25
Volt/Amps (min)	1,400	500
Average back-up time (min)	15 minutes	5 minutes
Line conditioning	Yes	No
Operating system compatibility	Windows-NT	n/a

SNMP support	Yes	No
--------------	-----	----

POWER PROTECTION: Option-2 (see 1.3.2.c *POWER SUPPLIES*)

Unit specification	Value
Quantity	2
Volt/Amps (min)	7.5 Kva
Average back-up time (min)	15 minutes
Line conditioning	Yes
Operating system compatibility	Windows-NT
SNMP support	Yes

SOFTWARE

- Microsoft Back Office Suite (which includes Windows-NT Server 4.0, Exchange Server, IIS, and Proxy Server)
- Microsoft Windows-NT Client 4.0 with (min) 32 user license
- Microsoft Office-97 Professional Edition with (min) 32 user license
- Hyena Centralized LAN Management
- Microsoft Access Self-paced Training Course
- Norton Anti-Virus
- StatSoft Corp. Statistica
- TSP Transportation Project Management
- Oracle Corp. Oracle-8 Personal Edition – 2 copies or 2 user license

CURRENT U.S. COST ESTIMATE (May, 99)

Individual package sizes and weights are not yet available, so the exact air freight cost cannot yet be estimated. Air freight costs average 10 to 15 percent of total costs.

DESCRIPTION	Qty	Unit Price		Extended Price	
		Low	High	Low	High
PC PII-350+ 64M 6G+ 10/100 MS Office	20	1,100	1,275	22,000	25,500
Server PII-400+ 256M 50G+ 10/100	1	8,000	10,000	8,000	10,000
17" monitor	21	380	420	7,980	8,820
24G DAT tape drive	1	1,000	1,400	1,000	1,400
NIC cards (PCI)	11	24	79	264	869
HP 4000TN printer	4	1,400	1,500	5,600	6,000
HP 4000T NIC card	1	230	250	230	250
LAN HUB 12 - 16 port	4	380	700	1,520	2,800
500 v/a battery backup	25	125	175	3,125	4,375
1,400 v/a UPS	1	400	650	400	650
Laptop	2	1,800	2,500	3,600	5,000
HARDWARE TOTAL				53,719	65,664
Micorsoft BackOffice NT 35 user license	1	9,370	9,370	9,370	9,370
Windows NT workstation (client)	11	270	270	2,970	2,970
Office-97 Professional (upgrade)	20	294	294	5,880	5,880
Office-97 Professional (full version)	12	490	490	5,880	5,880
Hyena LAN management	1	199	199	199	199
Micorsoft Access self-training	2	100	100	200	200
Norton Anti-virus	1	40	40	40	40
StatSoft Statistica	2	990	990	1,980	1,980
TSP Econometrics (site license)	1	1,680	1,680	1,680	1,680
Oracle-8 Personal Edition	2	500	500	1,000	1,000
SOFTWARE TOTAL				29,199	29,199
SYSTEM TOTAL				82,918	94,863

SERVICES

- Initial hardware and software installation – 4 weeks.
 - Unpack, install, verify each piece of hardware.
 - Design physical & logical LAN topography.
 - Provide & install cat-5 wiring & connectors to all components.
 - Load Windows NT on all new PC's (if not pre-loaded).
 - Convert all existing PC's to Windows NT & configure.
 - Install all Office products.
 - Configure the file server and all server based software.

- Configure each user PC and each one's application software.
- Verification of complete system operation.
- OPTIONAL: Install electrical wiring and UPS A-B switch.
 - 220/240 volt wiring to all office locations where PC's will be used.
- Independent transition technical advisor – 4 weeks.

DUTIES

- Provide continuous analysis and technical advice to all aspects of initial installation, implementation, and training.
- Help resolve all technical and organizational issues or disputes between and/or within the installer and MoT.
- Protect the interests of the donor and MoT.

MINIMUM QUALIFICATIONS

- B.S. Computer Science and minimum 15 years public or private sector application, or M.B.A. and minimum 10 years application.
- Business Administration degree and/or minimum 10 years business administration and management.
- Specific training and experience organizing, designing, installing, and administering Windows-NT based LAN's.
- Experience training users of Microsoft Office applications.
- Microsoft Office application training – 2 to 3 weeks each for all users.
 - From one to two weeks classroom training in all Microsoft Office applications, with emphasis on Word and Excell.
 - One week follow-up training and assistance at MoT.
- Microsoft Access database design, assistance, and technical training – 3 months intensive, 9 months intermittent for two system administrators.
 - Minimum 3 months classroom training on database design with emphasis on Microsoft Access.
 - Technical assistance at MoT as needed for 9 months.
 - Microsoft Access database design and design assistance from a qualified Microsoft Access analyst.
- LAN administration training – 6 months intensive, 6 months workshop for two system administrators.
 - Minimum 6 months classroom and dedicated self-help training on local area network administration, with emphasis on Windows-NT.
 - On-site technical assistance at MoT as needed for 6 months.
- Internet Service Provider (ISP) full access account – Continuous.
 - Donor funded internet access from Malawinet or other ISP, with 24 hour availability and full WEB access.
 - ISP account continuation after first year.

1.4 CONCLUSION

- As soon as possible, all necessary approvals must be obtained for the two MoT System Administrator positions, and approvals submitted in writing to USAID.
- Immediately following the review of this study and its recommendations, and after the above approvals have been issued, requests for bids should be issued for all of the listed hardware, software, and support.
- The two MoT System Administrator positions should be filled and technical training for these two individuals started prior to the commencement of system installation.
- The contract for initial system installation should be awarded and installation planning begun before any equipment is received or installed.
- A transition oversight committee should be appointed to discuss, review, and oversee all aspects of the system installation and transition process. This committee should consist of the following:
 - One representative from each of the major MoT departments and offices.
 - The primary representative of the firm to provide the initial system installation.
 - An independent technical advisor from USAID or other independent body.
- A source of funding must be sought for periodic on-going technical support and for the cost of supplies and operations beyond the first year.

#